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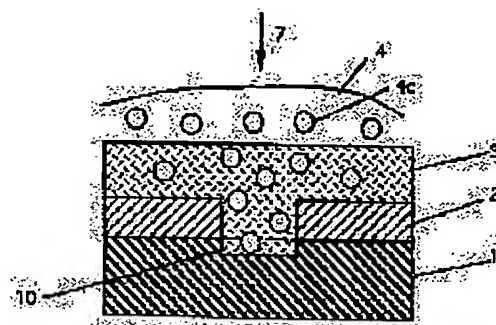
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## (54) WET ETCHING SOLUTION AND METHOD FOR WET ETCHING

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an etching soln. capable of an anisotropic etching in wet etching and to provide a method for executing the anisotropic etching using this.

SOLUTION: The etching soln. 4 holds a form of being divided into particle droplets or particles (by chemical particles) in which the state of the etching soln. is divided small untill the etching soln. is applied to a sample. This liq. chemical particles are covered with a coating film and are contained in a capsule 4c or are as they area. Moreover, the method of etching is executed in such a manner that a neutral soln. 3 is applied to the surface of the sample, which is fed with the liq. chemical particles by spraying. Thus, the liq. chemical arrives to the working part 10 in the surface of the sample with a speed, and the sample material is worked, but, in the side wall part, the liq. chemical is neutralized and is made ineffective, and anisotropic etching is made dominant.



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DETAILED DESCRIPTION

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## [Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the method of wet etching using the wet etching liquid and this which process material, such as a semiconducting crystal, a metal, and an insulator.

[0002]

[Description of the Prior Art] In the manufacturing process which carries out processing finishing of the material, such as a semiconducting crystal, a metal, and an insulator layer, precisely, wet etching is used and it is also positioned as one of the important technology now. wet etching forming arbitrary concavo-convex patterns in a sample front face, or finishing a sample front face in the shape of a mirror plane \*\*\*\* -- the hole of a sample -- it is used for the purpose which carries out dawn and cutting. Usually, since configuration processing on the front face of a sample is made by forming a pattern in a sample front face by the photoresist, making this into a mask, and carrying out wet etching of the material of a sample with a medical fluid, it has an advantage processible by the low cost.

[0003]

[Problem(s) to be Solved by the Invention] Since sufficient quantity of a medical fluid is always supplied to the processing side of a sample, the portion which touches a medical fluid can delete the conventional wet etching in the non-direction. For this reason, underetching of the mask edge was carried out and it had the fault which cannot perform processing as a mask size. This was called so-called isotropic etching and made into the essential property by wet etching. For this reason, for example by processing with a depth of several micrometers, since side etching of the same amount entered, the lower limit has formed only the pattern several micrometers or more. For this reason, it could not but depend on the dry etching technology using equipment expensive for forming a highly precise detailed pattern, and processing had taken time. Moreover, generally in the conventional wet etching, etching of an amount with the bad especially deep adhesion of a phot register mask had the fault which this mask material cannot bear to the medical fluid. For this reason, this invention aims at offering the etching reagent which can do anisotropic etching also in wet etching, and offering the method of performing anisotropic etching using this.

[0004]

[Means for Solving the Problem] It is required not to supply the medical fluid activated by that the component which processes a sample front face perpendicularly exists in order to perform anisotropic etching by wet etching, or the etching side attachment wall. The state of an etching reagent until the etching reagent made into the foundations of this invention in order to attain this purpose is supplied to a sample is characterized by this having the gestalt classified into \*\*\*\* or the particle (this is hereafter called medical fluid grain) divided small unlike the usual thing. Usually, although a medical fluid grain is \*\*\*\* of a liquid in ordinary temperature, it may cool this and may be the gestalt of a solid particle. Moreover, the particle may be contained in the above and the medical fluid grain (this is hereafter called particle content medical fluid grain), and this particle is injected by the sample front face together with a medical fluid grain, and it is used in order to give the operation which processes it perpendicularly more effectively. Moreover, the medical fluid grain and the medical fluid grain containing a particle may be wrapped and covered by the covering film (these are hereafter called the capsule containing a medical fluid grain, or capsule containing a particle content medical fluid grain, respectively), and the size of a capsule is selected with regards to the processing dimensional accuracy of a sample, and is usually a large area from several cm or less to mm. Moreover, in order to take out a medical fluid grain and a particle out of a capsule and to \*\*\*\*\* a sample front face with a medical fluid, there are the various methods of destroying with heat the covering film of (3) capsules which melt the covering film of (2) capsules with a solvent which is made to inject (1) capsule and is broken mechanically. Since the capsule containing these medical fluids is saved on a container or a film and can be set by the steady state, there is the feature which is easy to use. Next, the method of etching made into the foundations of this invention is made as follows using the above and a medical fluid grain. First, one method is arranging the neutralization solution which has a counteraction to a use medical fluid on a sample front face, supplying a medical fluid grain to this by injection, and \*\*\*\*\*ing to it. Although a medical fluid reaches the processing section on the front face of a sample with speed and sample material is deleted by the chemical reaction, since the material which the medical fluid which reached the side-attachment-wall section, and which is being activated is neutralized by the neutralization solution, and is in this field is not processed, anisotropic etching becomes dominant. Moreover, other methods are methods of performing precise processing, by only a constant rate's injecting and supplying the above and a medical fluid grain to a sample front face, and deleting the front face of sample material by the

chemical reaction, and a chemical reaction becoming weaker by this, or blowing away a medical fluid, stopping processing, and repeating this by making this process into 1 cycle. Vertical processing becomes dominant by supply of the directivity of injection energy, and the etching reagent of a constant rate. As mentioned above, the main point of this invention uses an etching reagent as a medical fluid grain, and this is supplied from a certain direction and it is based on having restricted the amount of the etching reagent when processing it further. There is the feature which can control volume correctly by using an etching reagent as a medical fluid grain. There is the feature which can control the amount of processings and configuration of etching by this method precisely. Moreover, the medical fluid used for this invention restricts the amount of an etching reagent, and since it neutralizes and uses this, even if it is composition which reacts chemically strongly, it has the feature in which good processing is made. Floor to floor time can be shortened by this, and there is the feature whose mask resistance of a phot register mask improves sharply by the same reason as the above.

[0005]

[Embodiments of the Invention] Example 1 drawing 1 is one example of the method of wet etching using the wet etching liquid and this by this invention. Moreover, drawing 2 is each one example of the capsule containing a medical fluid grain (a) which hits 1 \*\*\*\* of the wet etching liquid by this invention, and the capsule containing a particle content medical fluid grain (b). The example of the method of the wet etching by this invention is as follows. The aperture pattern of the photoresist mask 2 is formed on the Mo substrate 1. The etching reagent 4 which consists of capsule 4 containing medical fluid grain c which supplies the neutralization solution 3 of the alkali which has a counteraction to an acid medical fluid on the surface of a sample, and consists of solution of a sulfuric acid and phosphoric acid is supplied to a sample side by injection from the upper surface. The capsule of resin material explodes by collision on a sample front face, medical fluid \*\*\*\* flows out, and the front face of the processing section 10 is processed by etching. It is neutralized and the operation of etching of the medical fluid which flowed in the neutralization solution is lost. If it processes by fixing a sample to the electrode holder which has a rolling mechanism, spin dryness can do a front face. Even if it uses this spin dryness together and processes the above and the Mo substrate 1 deeply, the processing section 10 can form a breakthrough with a perpendicularly near configuration. This is applied to part manufacture of the aperture of the electron-beam-lithography equipment used as a highly precise metal mask etc., and can be contributed to the improvement in a performance of equipment. In addition, even if it sprays supply of the neutralization solution 3 of alkali by the spray on a sample, it may collect solutions, and may make neutralization liquid granular like an etching reagent, and may be made to inject it like a medical fluid. The etching reagent 4 which consists of capsule 4 containing medical fluid grain c may put in and supply a nozzle into the neutralization solution 3. One example of the wet etching liquid by this invention is as follows. The capsule simple substance containing a medical fluid grain which hits 1 \*\*\*\* of the wet etching liquid by this invention is shown in drawing 2 (a), and the capsule simple substance containing a particle content medical fluid grain is shown in drawing 2 (b). capsule 22a The capsule simple substance containing a medical fluid grain of drawing 2 (a) sets a medical fluid to \*\*\*\* 21a, wraps and covers these in resin atmosphere, and is the example which turned. capsule 22b Moreover, the capsule simple substance containing a particle content medical fluid grain of drawing 2 (b) wraps and covers the particle 23 which consists of abrasives, such as \*\*\*\* 21b of a medical fluid, and an alumina, in resin atmosphere, and is the example which turned. As for the particle 23 in a capsule, quantity is not limited. Making encapsulation of these etching reagents from a capsule with a big diameter with the technology which encloses a medical fluid with a capsule container, a small thing applies the so-called technology of the microcapsule currently used with an ink agent, medical medicine, etc., and is realizable. Moreover, not corroding the material of a capsule with a medical fluid grain does not need to say that material, such as glass and rubber, is also used with a requirement in addition to a macromolecule resin. These capsules are granular, and are used or are used, pasting a tape.

[0006] Other examples of the wet etching liquid by example 2 this invention are as follows. Medical fluid grain simple substance 31a which hits 1 \*\*\*\* of the wet etching liquid by this invention is shown in drawing 3 (a), and a particle content medical fluid grain simple substance is shown in drawing 3 (b). It is the composition of the particle content medical fluid grain simple substance of drawing 3 (b) which was made to contain the particle 33 set to medical fluid grain simple substance 31a of drawing 3 (a) from abrasives, such as an alumina, and was made together with medical fluid grain simple substance, 31b. Usually, although these medical fluid grains are \*\*\*\* of a liquid in ordinary temperature, the gestalt which cooled the medical fluid and was made into the solid particle (ice-like particle) is sufficient as them. Moreover, these wet etching liquid does not exist in a steady state, but the gestalt of a liquid or a solid-state is usually made as an etching reagent of this invention by equipments, such as a spraying mechanism. When processing a metal plate at high speed, blasting of an ice-like particle is effective for an anisotropy. Machine distortion is introduced into a processing side by this, and a working speed increases by it. Moreover, it is characterized by adding the function which can supply the wet etching liquid of a constant rate periodically to the equipment which supplies a medical fluid grain or a particle content medical fluid grain.

[0007] Example 3 drawing 4 is other examples of the method of wet etching using the wet etching liquid by this invention. The aperture pattern of the photoresist mask 42 is formed on the Si substrate 41. The etching reagent 44 which consists of medical fluid grain 44c which made fluoric acid and the nitric acid the principal component from the sample upper surface is carried out pressurization 46, only a constant rate is periodically supplied to a sample side by injection from a nozzle 45; and Si is \*\*\*\*\*ed by this. Moreover, the penetrant remover 47 of pure water is carried out pressurization 49, it synchronizes periodically after etching from a nozzle 48, a sample side is supplied, and a halt and washing of processing are performed. This may be N2 gas at a change of pure water. Only a fixed quantity can supply a small amount of medical fluid to a sample front face uniformly correctly, and the chemical reaction of etching by this can be controlled by this method not to go on until it is saturated and a medical fluid new next is supplied. Pure water and supply of N2 are used for the purpose which stops

etching steeply or removes Si compound. It turns out that the cross-section configuration where the processing section 40 of Si is almost perpendicular is acquired by such method, and the depth of etching is controlled with high precision.

[0008] Example 4 drawing 5 is another example of the method of wet etching using the wet etching liquid by this invention.

The wet etching liquid of composition of having pasted up the capsule 54 containing the medical fluid grain which made the hydrochloric acid and the nitric acid the principal component on the tape 55 describes how to form the processing section 50 to the SUS-substrate 51. The aperture pattern of the photoresist mask 52 is formed on the SUS substrate 51. The above-mentioned tape with a capsule is put and pressurized on this front face, and a medical fluid is picked out from a capsule. A capsule may be melted with a solvent 53 and a medical fluid may be taken out. Since the amount of a medical fluid is limited, etching stops in the place whose effect of a medical fluid was lost. It is sent one after another, 56 and the new capsule section are supplied to a sample front face, etching is repeated, and the tape which consists of the shape of a roll is performed. Unlike the conventional wet etching, this method has extremely few amounts of medical fluids, and has the feature to which etching is carried out by semi- dry type. For this reason, the processing section of etching becomes easy composition and has the feature for which waste fluid processing of a medical fluid also becomes unnecessary, and can do etching by the near method pollution-free.

[0009]

[Effect of the Invention] (1) By using wet etching liquid as a medical fluid grain or the capsule containing a medical fluid, only an exact amount can supply now the medical fluid which had a vertical component in the sample front face, and anisotropic etching which can respond to micro processing by wet etching came be made.

(2) A neutralization solution is arranged on a sample front face, and the amount of etching can be precisely controlled by making the above and wet etching liquid blow off to this, and anisotropic etching came be made effectively.

(3) By using the capsule containing a medical fluid adhered to the tape, wet etching can carry out now by semi- dry type, and a near art came to be obtained pollution-free.

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[Translation done.]